'Nano Cocktail' Provides One-Two Punch in Destroying Cancerous Tumors

By Michael Dabney

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Researchers in California and Massachusetts have teamed up to develop a "cocktail" of different nanometer-sized particles that work in concert within the bloodstream to locate, adhere to, and kill cancerous tumors in laboratory mice.

The findings, published recently in the Proceedings of the National Academy of Sciences, represent "the first example of a combined, two-part nanonsystem that can produce sustained reduction in tumor size in live animals," said Dr. Michael Sailor, professor at the University of California (UC), San Diego, in a press release.

Such research allows scientists to gain further insight into designing better cancer treatments that more accurately locate and destroy tumors early while exposing patients to less drug dose toxicity.

Nanotechnology, or "nanotech," is a revolutionary area of science and medicine that involves controlling matter on an atomic and molecular scale, in addition to developing materials or devices within such minute dimensions.

In their study, UC San Diego chemists, bioengineers at the Massachusetts Institute of Technology (MIT), and cell biologists at UC Santa Barbara developed a system containing two nanoparticles the size of only a few nanometers—or a thousand times smaller than the diameter of a human hair—that can be injected into the bloodstream. One type of nanoparticle was designed to find and adhere to tumors in mice, and the other to kill those tumors.

"Together, they form an effective one-two punch in destroying the cancer," said Sailor.

The particle that seeks out and sticks to tumors is made up of iron oxide, which molecularly forms a polymer sheath around individual bioengineered-gold nanorods, creating chain-like links called nanoworms. The iron oxide particle has a special magnetic property that causes it to light up brightly under magnetic resonance imaging (MRI). This permits tumors to be detected in an early stage of cancer.

Likewise, the nanoparticles designed to attack the tumors contain the same nanorods but appear alongside liposomes (tiny bubble structures made out of cell membrane material), which the

researchers filled with dosage of the cancer drug doxorubicin. After tumors are located by the nanorods, the liposomes deliver the payload of doxorubicin to the tumors and kill them.

"Think of them like soldiers attacking an enemy base," Sailor explained in a press release. "The gold nanorods are the Special Forces, who come in first to mark the target. Then the Air Force flies in to deliver the laser-guided bomb. The devices are designed to minimize collateral damage to the rest of the body."

Although nano cocktails are used in aspects of cancer treatment today (mainly when multiple drug molecules are needed to treat the disease on more than one front), the effectiveness of the therapy is often limited because all elements of the therapy do not work in harmony, said Dr. Sangeeta Bhatia of MIT's Koch Institute for Integrative Cancer Research.

For example, sometimes a nanoparticle "may not be able to stick to tumor cells once it finds them," she said. Likewise, "a particle that is engineered to adhere tightly to tumors may not be able to circulate in the body long enough to encounter one in the first place."

"Our approach to getting nanoparticles to work in concert in mice has been effective, but that does not mean it will necessarily translate effectively for humans, so we have more investigation to do," Sailor added. Other goals in nano cocktail research, he said, are to better engineer nanoparticles to locate incipient tumors in deep areas of the body (including the brain) and to expose patients to less drug toxicity while tumors are eliminated.

Although much work is still needed, Sailor hopes that nano cocktails will be an effective and routine mode of treating cancer in the next two to three years. "I can envision patients, especially those with a family history of cancer or other high risks factors, coming to their physician every several years to receive their injection of a nano cocktail that is specifically tailored to their genetic makeup and medical history," he said.

The abstract of this study can be viewed at http://www.pnas.org/content/107/3/981.abstract

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